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ABSTRACT

An instructor's manual and student activity guide on air conditioning, refrigeration, and heating units are provided in this set of prevocational education materials which focuses on the vocational area of trade and industry. (This set of materials is one of ninety-two prevocational education sets arranged around a cluster of seven vocational offerings: agriculture, home economics, distributive education, health occupations, world of work, trade and industry, and office occupations.) The instructor's guide is organized into the following elements: title of activity, duration of activity (four to ten periods), activity goals, eight instructional objectives, related vocational clusters, and activity implementation (description, safety precautions, materials needed, teacher preparation prior to class, during the class, follow-up activities, answer key to student check point activities and masters for duplication). The student activity guide is organized into three units: thermostats, warm air blower, and wall heaters. Step-by-step instructions (narrative and illustrations) for completing each instructional objective are provided. At the end of each set of instructions is a student check point (evaluation activity). Occupational descriptions for a hot air furnace installer and repairer, heat-transfer technician conclude the document. (JH)

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ED169376

T & I–AIR CONDITIONING, REFRIGERATION, AND HEATING – HEATING UNITS

Kit No. 87

INSTRUCTOR'S MANUAL

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In Cooperation With

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1978

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TITLE OF ACTIVITY

Kit No. 87, T & I—Air Conditioning, Refrigeration, and Heating – Heating Units

DURATION

Main Activity: 3 – 5 periods
Follow-up: 1 – 5 periods

GOALS

Thermostats

The student will understand the operation of a thermostat.

The student will name the components of a thermostat.

Warm Air Blower

The student will understand the operation of a forced warm air system blower.

The student will learn how to adjust a warm air blower.

The student will learn how to maintain a warm air blower.

Wall Heaters

The student will understand the operation of a baseboard heating system.

The student will learn how to maintain a baseboard heating system.

The student will learn the terminology related to baseboard heating units.

INSTRUCTIONAL OBJECTIVES

Thermostats

The student will name the parts of a thermostat and tell the purpose of each part.

The student will examine a thermostat that is in a circular housing.

Warm Air Blower

The student will locate the parts of a warm air blower.

The student will press the V-belt to check for proper tension.

The student will check the pulley alignment.

The student will adjust the blower speed.

Wall Heaters

The student will indicate the reasons why a wall heater might not work.

The student will change the heating element in a wall heater.

VOCATIONAL CLUSTERS

Agriculture

ACTIVITY IMPLEMENTATION

A. Activity Description

The student will have the opportunity to work with three mock-ups that are representative of equipment found in the field of heating. Through these mock-ups, they will learn how these systems work and perform some basic maintenance operations.

B. SAFETY

No units are to be worked on while plugged in.

The blower unit must have the safety guard on while the unit is running.

C. MATERIALS

1. Audio Visual Equipment
   None
2. Technical Equipment
   - 3 Blower mock-ups
   - 3 Thermostat mock-ups
   - 3 Wall heater mock-ups
   - 6 Common screwdrivers
   - 3 Phillips screwdrivers
   - 3 Allen wrenches
   - 3 Open end wrenches – 3/8"
   - 3 Open end wrenches – 7/16"
   - 3 Heating elements
   - 3 Carpenter's squares
   - 3 Portable tachometers

3. Expendable Materials
None

D. Preparation Prior to Class

Read through the student learning activity guide to familiarize yourself with the activity.

Group the mock-ups by areas in different locations of the classroom.

By each mock-up of the blower, place the following tools:

1 Common screwdriver
1 Allen wrench
1 Open end wrench – 3/8"
1 Open end wrench – 7/16"

By each mock-up of the wall heater, place the following tools:

1 Common screwdriver
1 Phillips screwdriver
1 Heating element

E. During Class Session

Introduce the students to the activity.

Divide your students into nine groups and assign each group a mock-up. When they complete working with a mock-up, they may move to one they haven't completed if it isn't being used.

Be sure to enforce any safety rules.

Assist only when called upon.

F. Follow-up Activities

1. View Fact Sheet.
2. Locate jobs using the want ads.
3. Visit a large heating installation company.
4. Visit your local area vocational center.
5. Using the portable tachometer, have students check the R.P.M. of the shaft. Students can then vary the adjustable pulley and see if there is a change in the R.P.M.

ANSWER KEY

THERMOSTATS, INSTRUCTIONAL OBJECTIVE I

1. Bimetallic element
2. Mercury
3. Contact points
4. Base plate
5. Anticipator control
6 Anticipator element
7. Temperature selector level
8. Glass tube
9. Thermostat housing
10. Thermometer
11. Temperature selector dial

WALL HEATERS, INSTRUCTIONAL OBJECTIVE II

A – Grill
E – Contact Lugs
F – Wiring
B – Spring clip
C – Heating element
D – Thermostat

WARM AIR BLOWER, INSTRUCTIONAL OBJECTIVE IV

1. B
2. B
3. A
4. C
5. C

MASTERS FOR DUPLICATION

View Fact Sheet
Thermostats, Instructional Objective I
Wall Heaters, Instructional Objective II
Warm Air Blower, Instructional Objective IV

VIEW FACT SHEET

NAME _____ CLASS _____ OCCUPATION _____

A. List the advantages (good points) of this occupation (job).

B. List the disadvantages (bad points) of this occupation (job).

C. List three things you should know to do this occupation (job).
1.
2.
3.

D. What type of education should you get to be prepared (do) for this occupation (job)?

E. What courses must you take to go into this occupation (job)?

F. What do you think your future in this occupation (job) will be?

G. What wage can you expect in this occupation (job)?

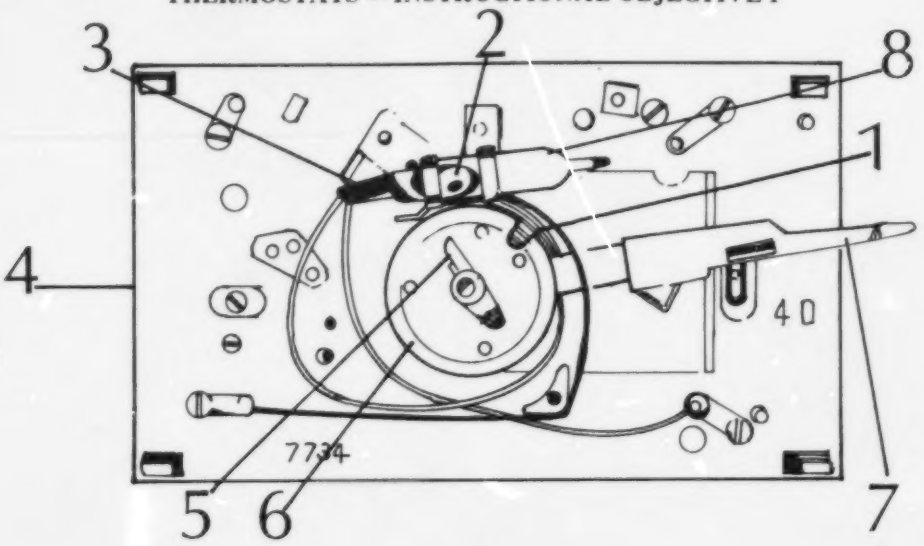
H. What are the working hours of this occupation (job)?

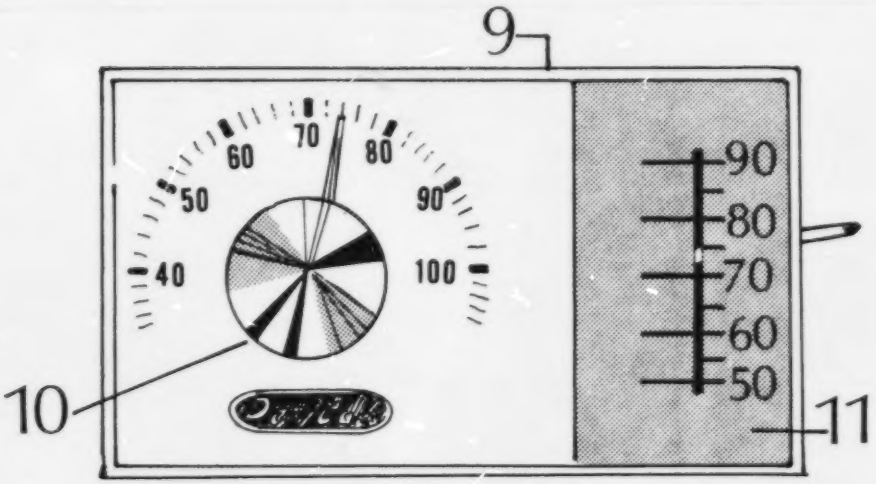
I. To learn more about this occupation (job), write to:

J. Using a scale of 1 to 5, circle the number that measures your interest in this occupation (job) as a possible career.

I don't like it. 1 2 3 4 5 I like it.

C





1_____ 7_____

2_____ 8_____

3_____ 9_____

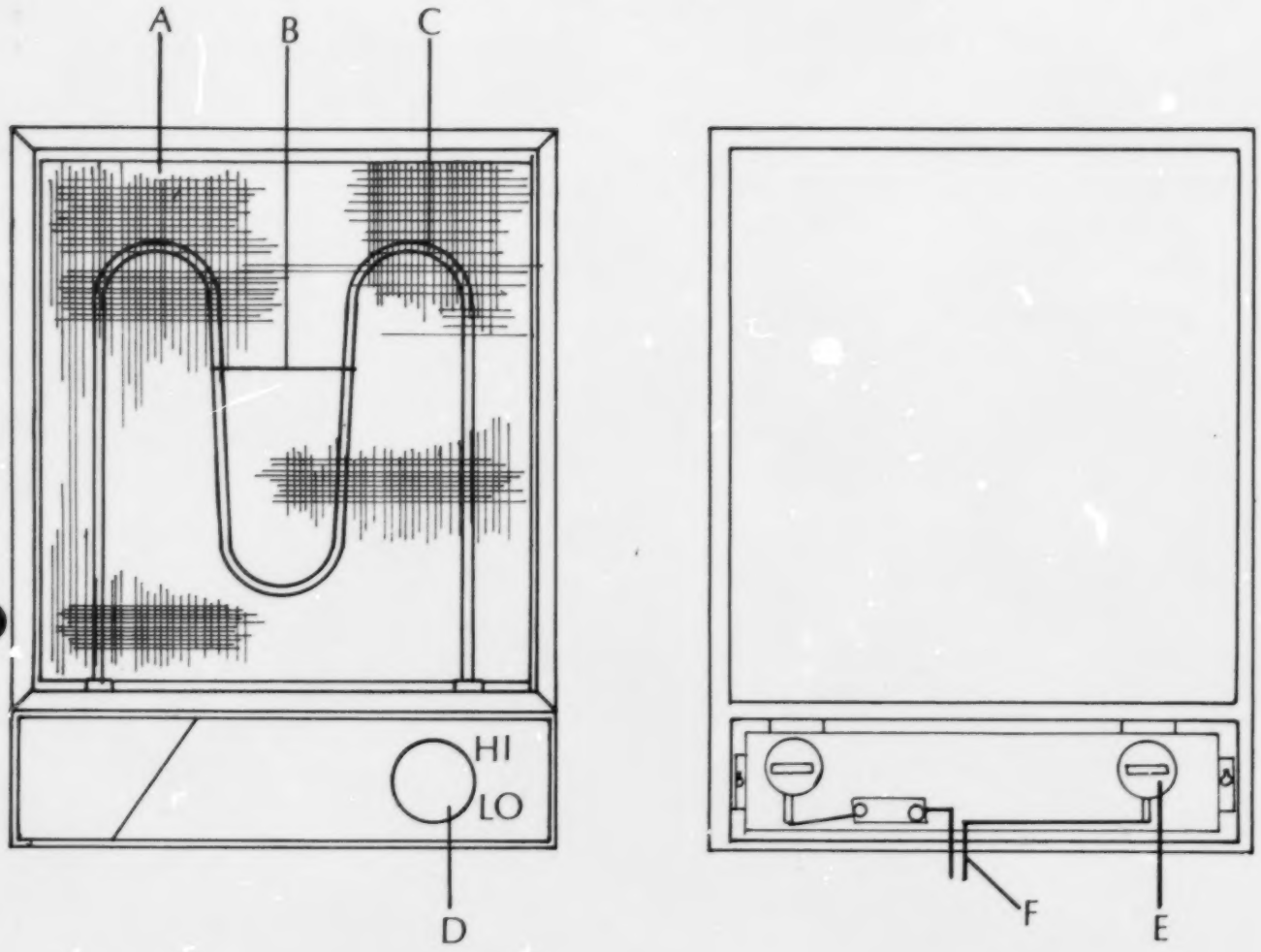
4_____ 10_____

5_____ 11_____

6_____

WALL HEATERS

INSTRUCTIONAL OBJECTIVE II



Grill _____

Contact Lugs _____

Wiring _____

Spring Clip _____

Heating Element _____

Thermostat _____

STUDENT ANSWER SHEET

WARM AIR BLOWER, INSTRUCTION OBJECTIVE IV

1. A noisy blower is probably caused by:

   a. Air velocity being too low
   b. The blower running too fast
   c. Warped contact points

2. If the V-Belt is worn it is probably because:

   a. The anticipator was not functioning
   b. The pulleys were not aligned
   c. Both of the above

3. Power loss is probably the result of:

   a. Too much tension on the V-Belt
   b. The blower running too fast
   c. A bent bimetallic element

4. To adjust the blower speed you must adjust the width of the:

   a. Fan pulley
   b. Velocity pulley
   c. Motor pulley

5. The safety guard is on the display model:

   a. To make this whole activity hard to do
   b. To make it hard for you to see what is happening
   c. To protect you from being cut or hurt by the fan blades or pulleys

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STUDENT
LEARNING ACTIVITY GUIDE

Prepared by

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THERMOSTATS

STUDENT LEARNING ACTIVITY GUIDE

THERMOSTATS

INTRODUCTION:

Most home heating systems are controlled by one or more thermostats. A thermostat is simply a switch that turns a heating system on or off to keep a room close to the temperature that is set on the thermostat.

You have probably heard the thermostat in your home "click" on or off or have noticed that your heating system does not run all the time. This on–off action of your heating system is controlled by the thermostat.

In this activity you will learn how a thermostat works and how to keep your thermostat in good working order.

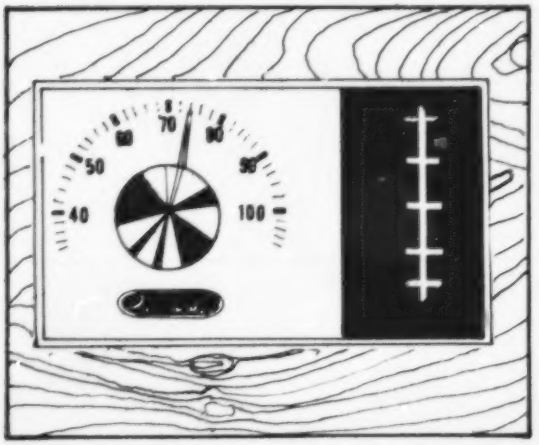
GOALS

1. The student will understand the operation of a thermostat.

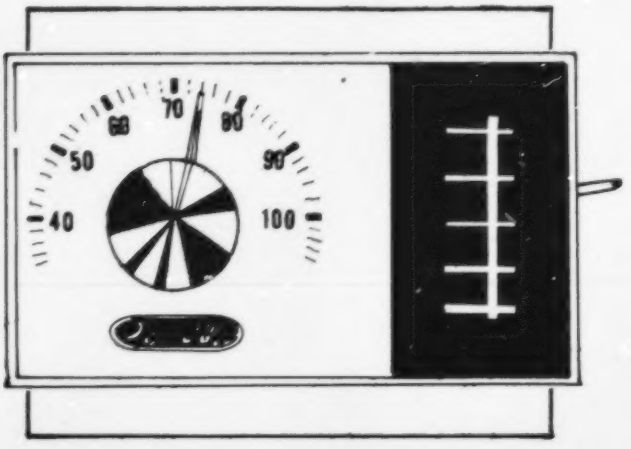
2. The student will name the components of a thermostat.

Instructional Objective 1

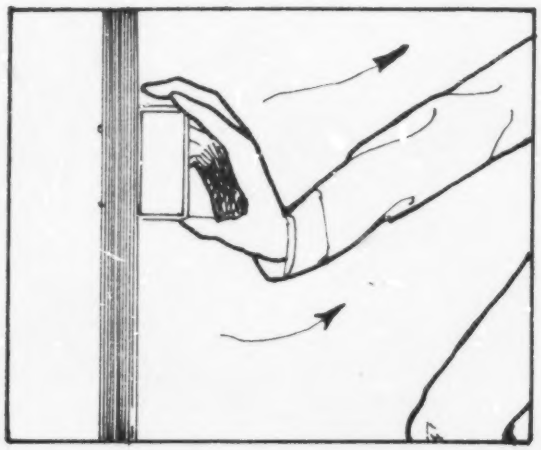
The student will name the parts of the thermostat and tell the purpose of each part.



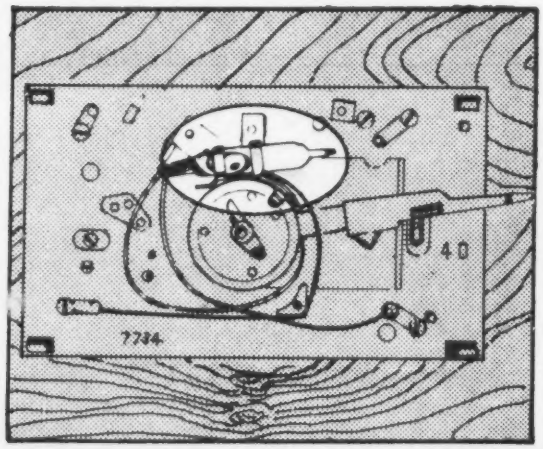
STEP 1 – Look at the Dayton thermostat on the display board. Be sure the display board is unplugged.



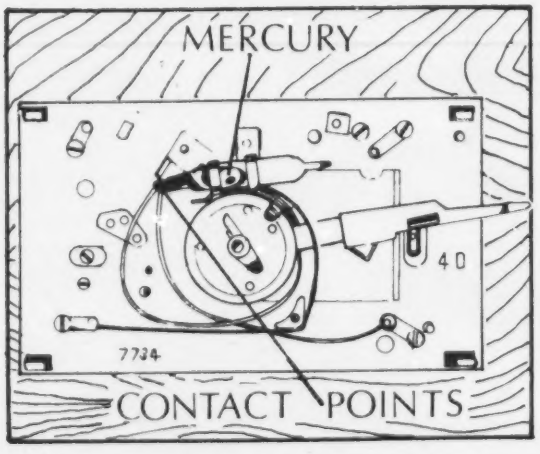
STEP 2 – The plastic cover over the thermostat is called the thermostat housing. The thermostat housing contains a thermometer and a temperature selector dial.



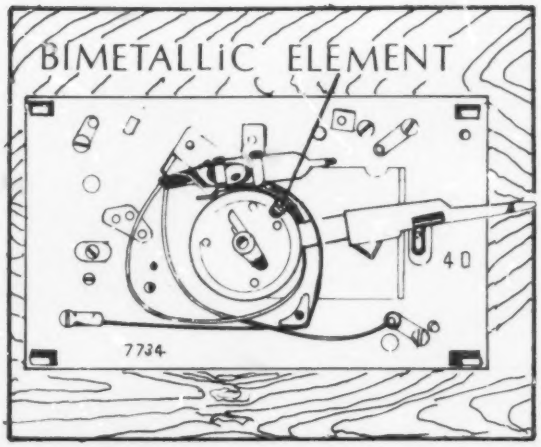
STEP 3 – Remove the thermostat housing by pulling it toward you, gently.



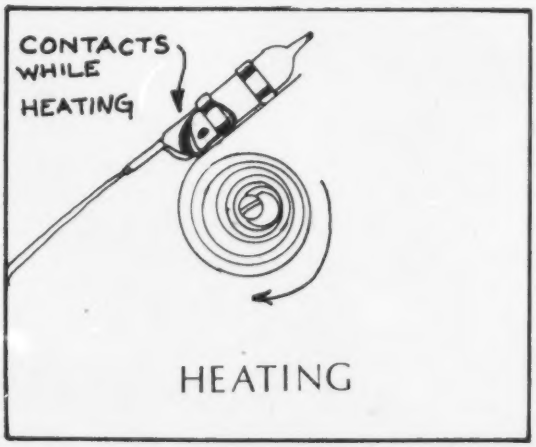
STEP 4 – You will see a glass tube at the top of the thermostat.



STEP 5 – This tube contains a small amount of mercury and contact points.

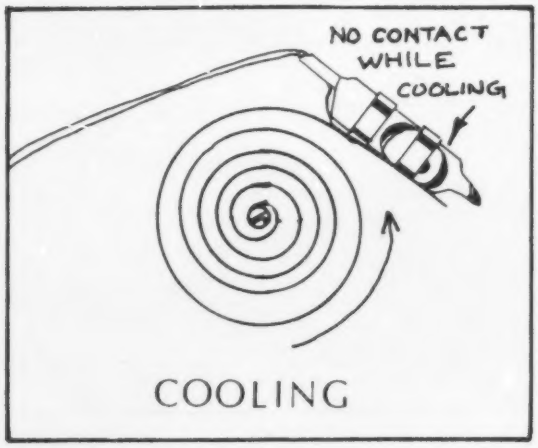


STEP 6 – You will see that the glass tube is mounted on a coiled metal strip that looks like a spring. This is called the Bimetallic Coil or Bimetallic Element.

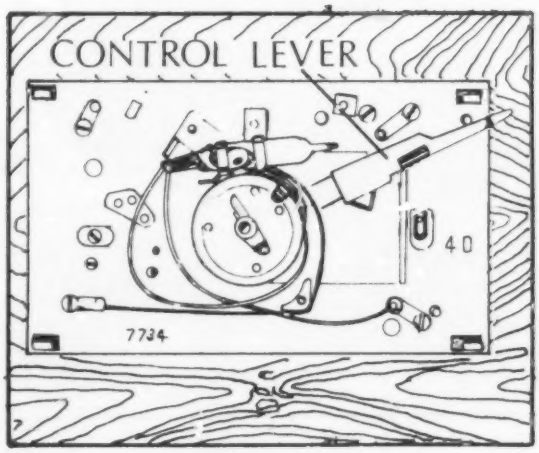


STEP 7 – This coil or Bimetallic Element is the heart of the thermostat. The coil is made by joining two different types of metal back-to-back and winding them into a coil. When this coil is heated, it winds up.

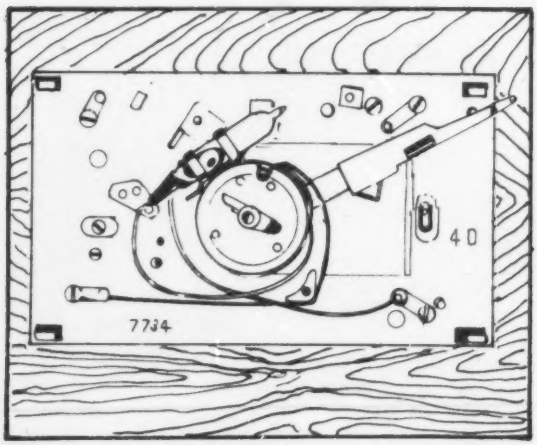
13



STEP 8 – When the Bimetallic coil cools, it unwinds.



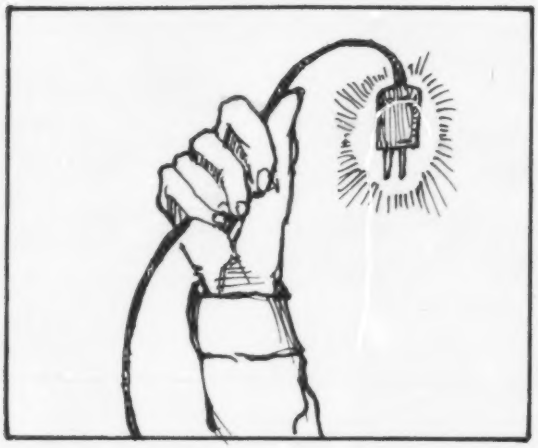
STEP 10 – You will notice that this procedure causes the Mercury, to move to the left of the glass tube – touching the contact points causing the heating element below the thermostat to turn on ––– watch the Bimetallic coil "wind up" until the mercury moves to the right side of the glass tube causing the heating element to turn off.



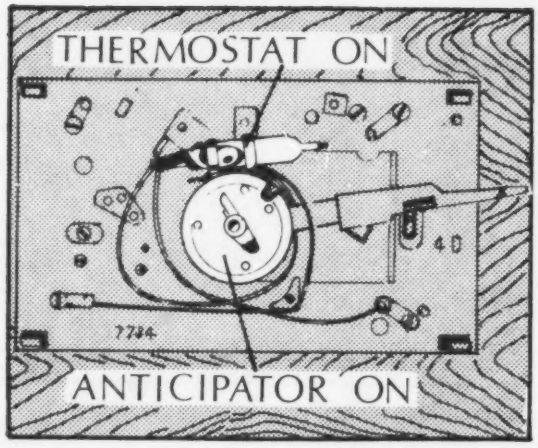
STEP 9 – Plug in the display board and push the control lever on the thermostat to the highest position.

STEP 11 – Watch the Bimetallic Element cool – the mercury will start to move toward the contact points.

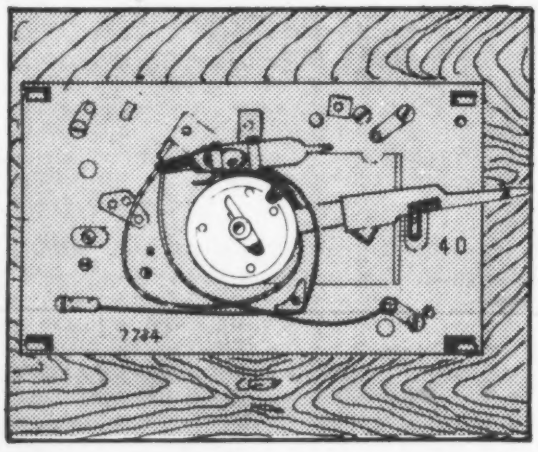
14



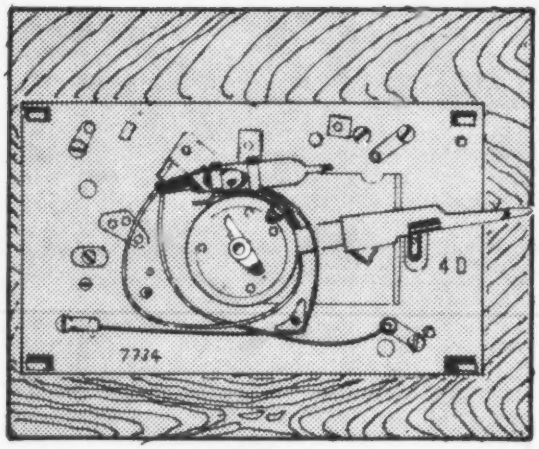
STEP 12 – Unplug the Display Board.



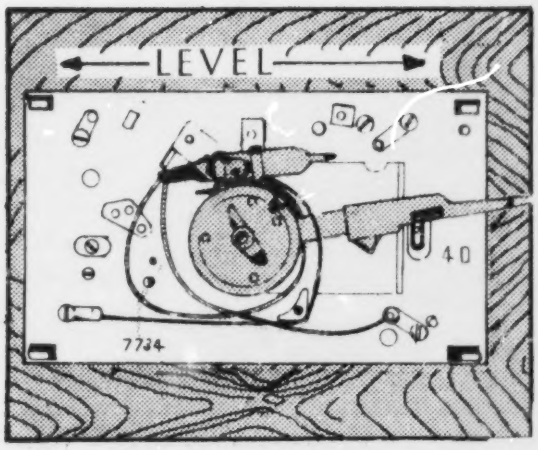
STEP 14 – When the thermostat is turned on, the anticipator is turned on and helps heat the Bimetallic element at the same speed as your heating system heats your home. The anticipator keeps the heating system from getting your home too hot.



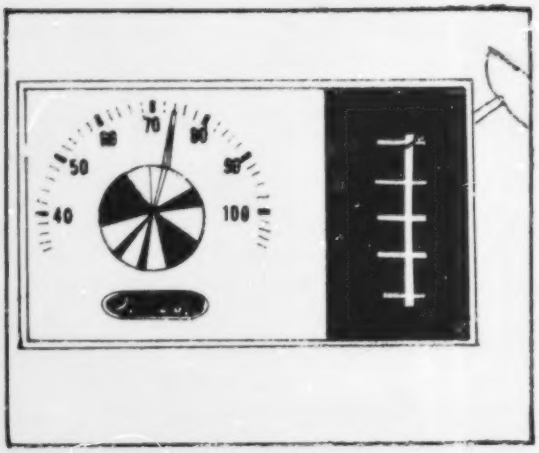
STEP 13 – Look again at the thermostat and the Bimetallic Element. You will notice that there is a small disc about the size of a quarter in front of the Bimetallic Element. This disc is a very small heating element called an Anticipator.



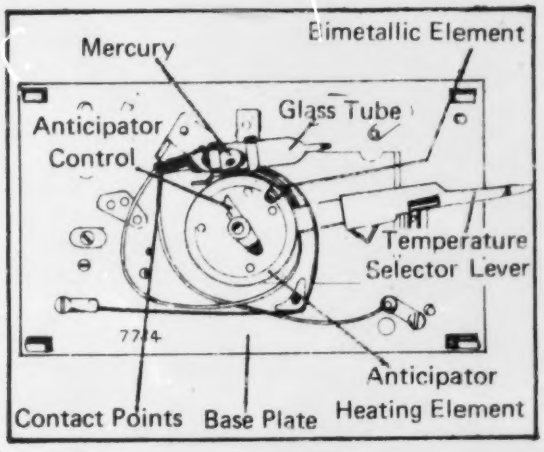
STEP 15 – Look at the anticipator. There is a metal pointer touching the anticipator heating element. This is the anticipator control. The anticipator control adjusts the anticipator to make it heat the Bimetallic element at the same speed as your heating system heats your home. THE ANTICIPATOR IS ADJUSTED WHEN YOUR HEATING SYSTEM IS INSTALLED AND IT SHOULD NEVER BE MOVED. DO NOT TOUCH THE ANTICIPATOR CONTROL.



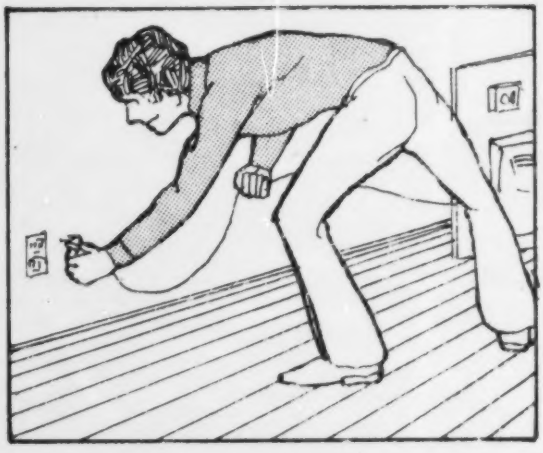
STEP 16 – The plastic back of thermostat is called the Base Plate. The Base Plate must be installed so that the top edge is level. This allows the Mercury in the glass tube to work properly.



STEP 18 – Replace the thermostat housing.



STEP 17 – Review the parts of the thermostat.



STEP 19 – Unplug the Display Board.

CHECKPOINT

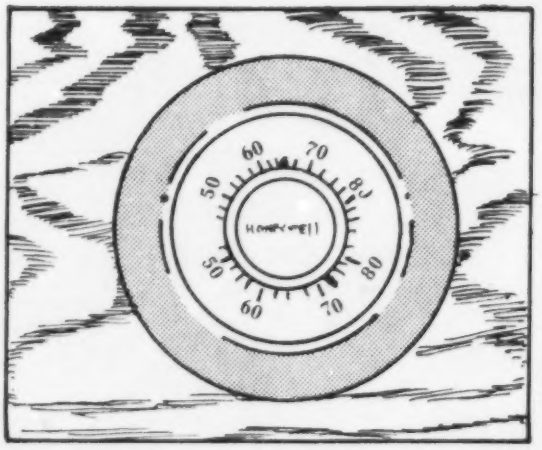
Go to your instructor and get the handout for Thermostats, Instructional Objective I.

Look at the illustrations of the thermostat. On the blank line under the illustrations, write in the names of the parts next to the number that matches the number in the illustration.

Go back to your instructor and ask to see the answers.

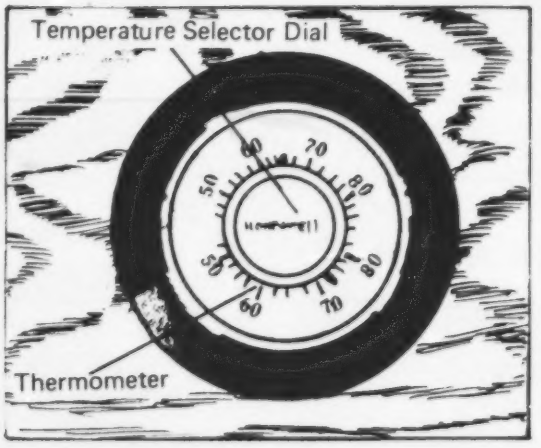
Instructional Objective II

The student will examine a thermostat that is in a circular housing.

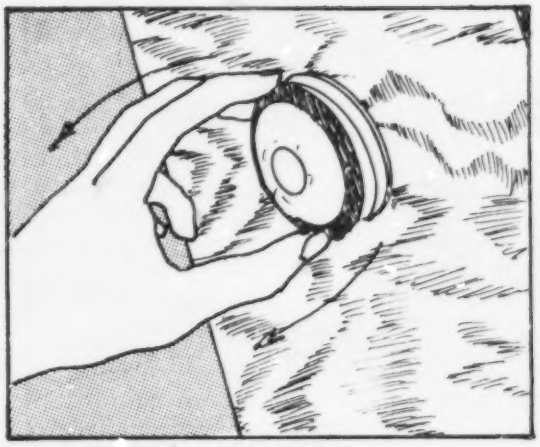


STEP 1 – We are now going to look at the Honeywell thermostat on the display board.

The Honeywell thermostat has the same parts and works the same way as the Dayton thermostat. Some of the parts will look different and be in different places. Be sure the Display Board is unplugged.

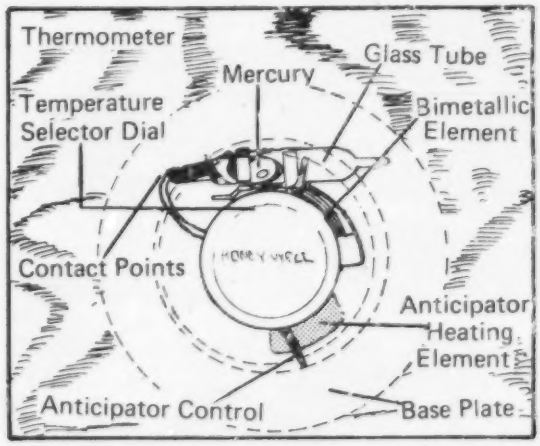


STEP 2 – The thermostat housing on the Honeywell thermostat contains a thermometer and a temperature selector dial.



STEP 3 – Remove the thermostat housing by pulling it toward you, gently.

STEP 4 – See how many parts of the thermostat you can name.



STEP 5 – These are the parts of the Honeywell thermostat.

STEP 6 – Plug in the Display Board. Move the temperature Selector Dial back and forth. Notice the movement of the mercury in the glass tube (Mercury switch) and the operation of the heating unit below the thermostat.

Check Point

Were you able to identify the parts on this thermostat? Did you notice how the operation of this is the same?

WARM AIR BLOWER

INTRODUCTION

Over half of the home central heating systems in America are forced warm air type systems. This type of system is efficient in that it keeps the house more comfortable by circulating the entire volume of air in the house continuously. All of these systems contain a warm air blower to circulate the air throughout the house.

In this activity you will learn how a warm air blower works and how to maintain and adjust your forced warm air type heating system.

GOALS

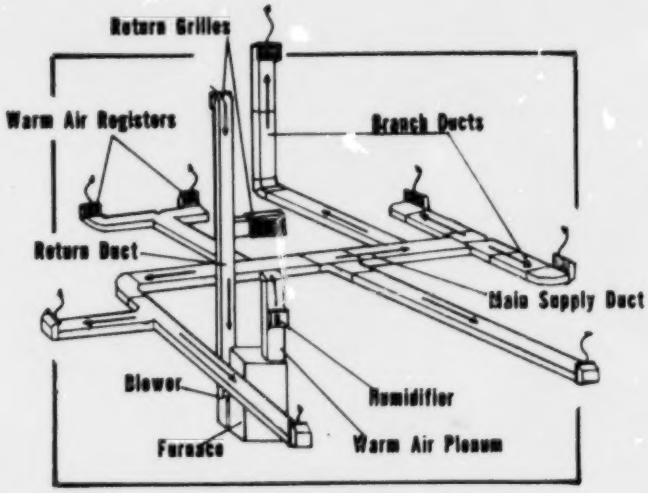
1. The student will understand the operation of a forced warm air system blower.

2. The student will learn how to adjust a warm air blower.

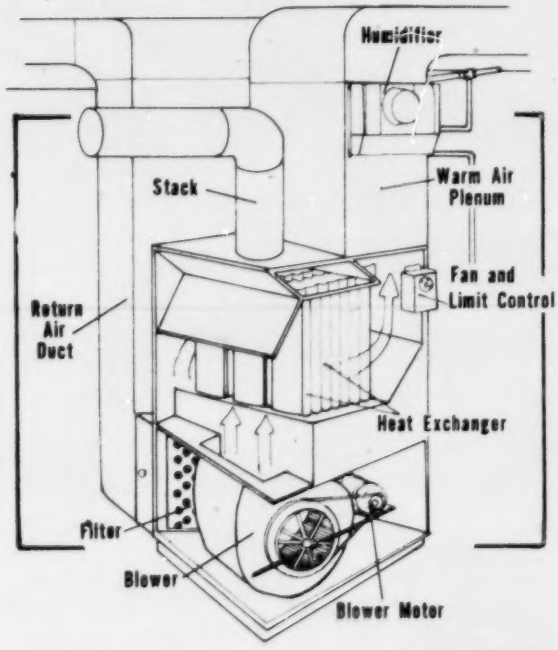
3. The student will learn how to maintain a warm air blower.

Instructional Objective 1

The student will locate the parts of a warm air blower.



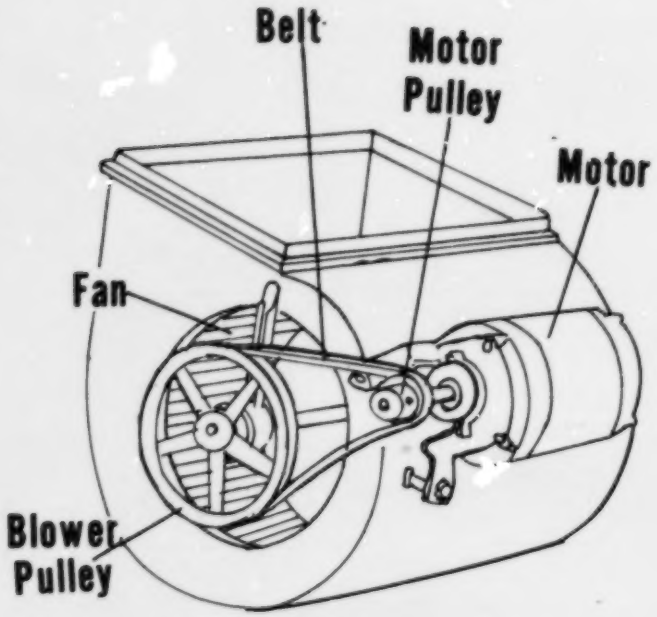
STEP 1 – To help you better understand the purpose of a warm air blower, the above diagram is provided. The diagram shows the paths the warm air takes as it moves away from the furnace.



STEP 2 – This is a diagram of a forced air furnace including the warm air blower.

Instructional Objective 11

The student will press the V-Belt to check for proper tension.

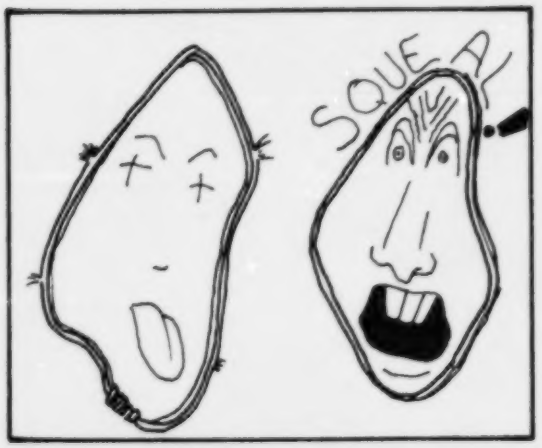


STEP 3 – The warm air blower consists of a squirrel cage fan,

STEP 4 – a motor

STEP 5 – a V-Belt

STEP 6 – and pulleys.

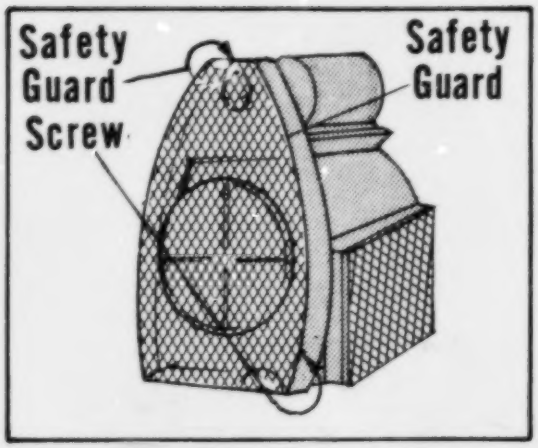


STEP 1 – Excessive wear and power loss are the result of too much tension on the V-Belt. Belt slippage or squeal and power loss are the result of too little tension on the V-Belt.

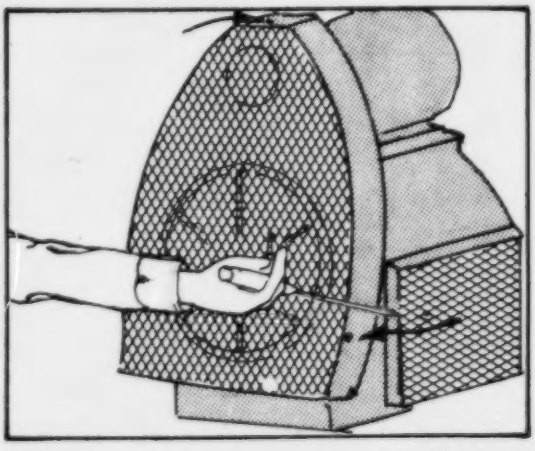
Check Point

Were you able to locate the parts of the blower?

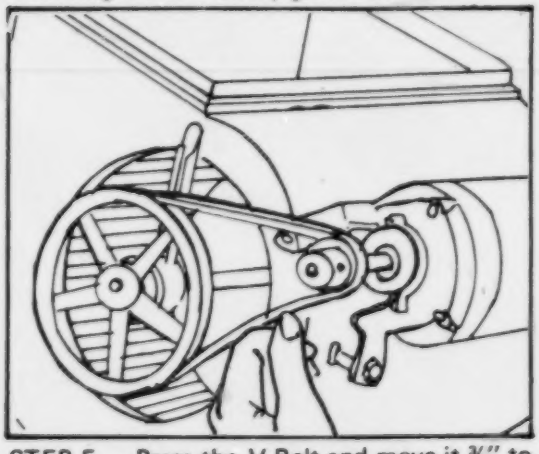
STEP 2 – Look at your Display Model Warm Air Blower.



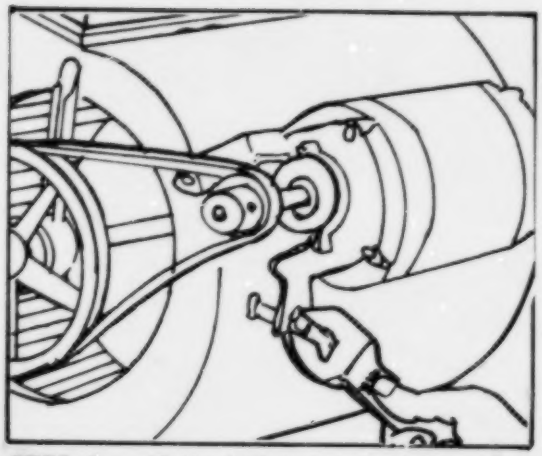
STEP 3 – You will notice that a safety guard is installed to help protect you from the pulleys on the warm air blowers. DO NOT – FOR ANY REASON – PLUG IN THE DISPLAY MODEL WHILE THIS GUARD IS OFF.



STEP 4 – Make sure the Display Model is unplugged. Remove the safety guard by removing the two safety guard screws.



STEP 5 – Press the V-Belt and move it ¾" to one inch (approx. 2 cm).



STEP 6 – If the V-Belt is too tight or too loose adjust the tension by turning the motor adjustment bolt.

Check Point

Did you remove the safety guard? Did you check the belt tension?

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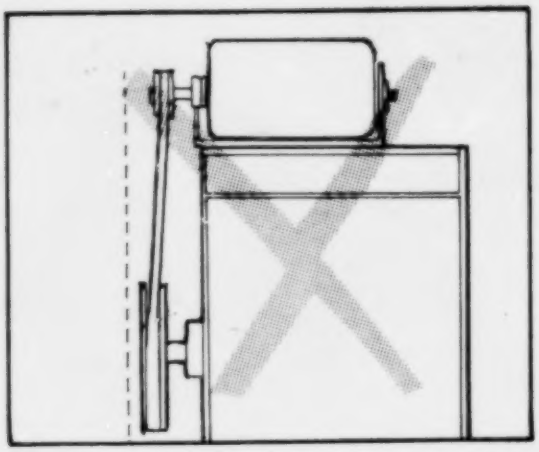
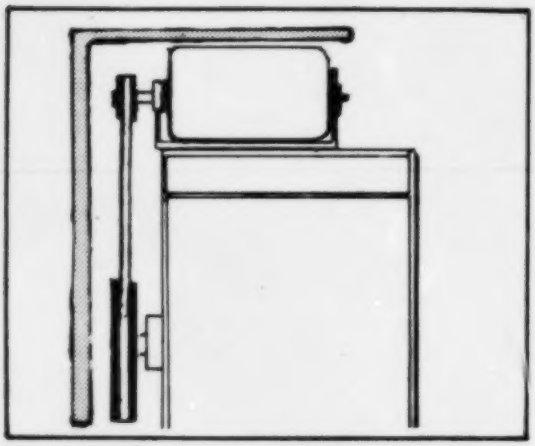
Instructional Objective

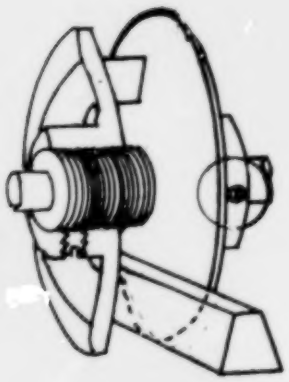
The student will check the pulley alignment.



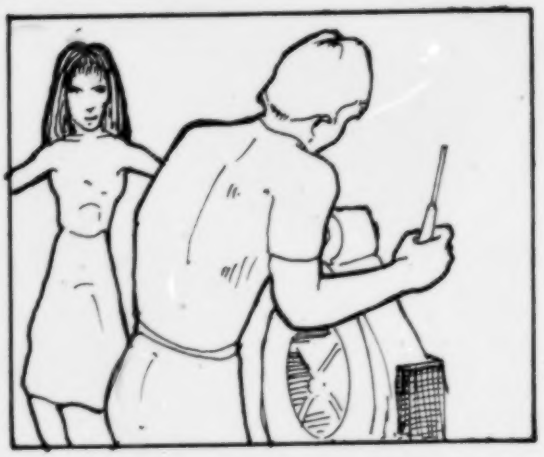
STEP 1 – Wear and power loss occur if the pulleys are not in line.



STEP 2 – To check the pulley alignment, use a carpenter's square to make sure that the pulleys are parallel to each other and at a right angle to the motor housing.



STEP 3 – To adjust the pulley alignment – loosen the inner set screw on the motor pulley and move the pulley to the proper position.



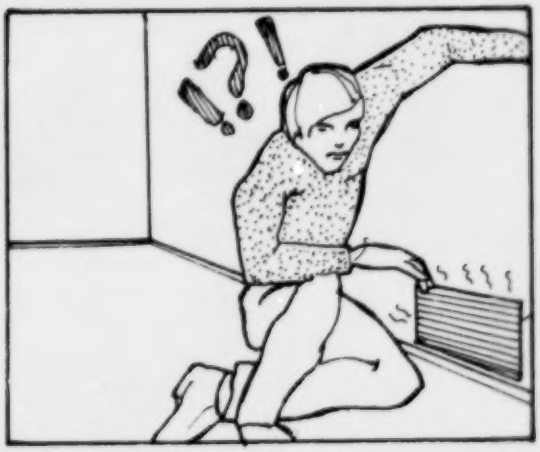
STEP 4 – Tighten the inner set screw.

Check Point

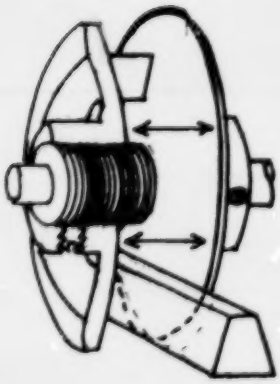
Were you able to align the pulleys?

Instructional Objective IV

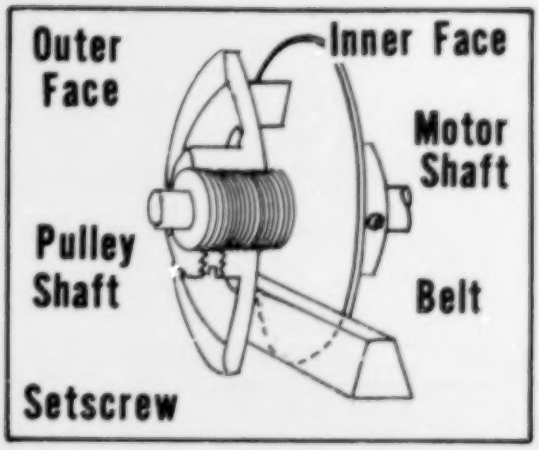
The student will adjust the blower speed.



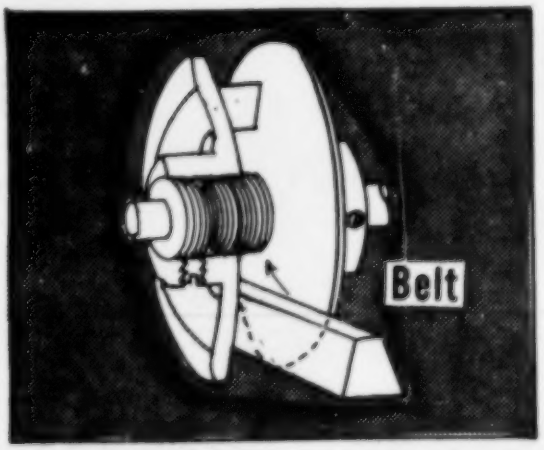
STEP 1 – A blower that is running too fast is noisy and inefficient – a blower that is running too slow does not move enough air to keep the house comfortable.



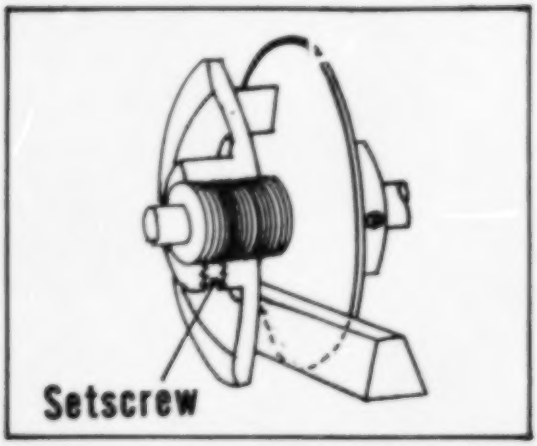
STEP 2 – To adjust the blower speed you must change the width of the motor pulley.



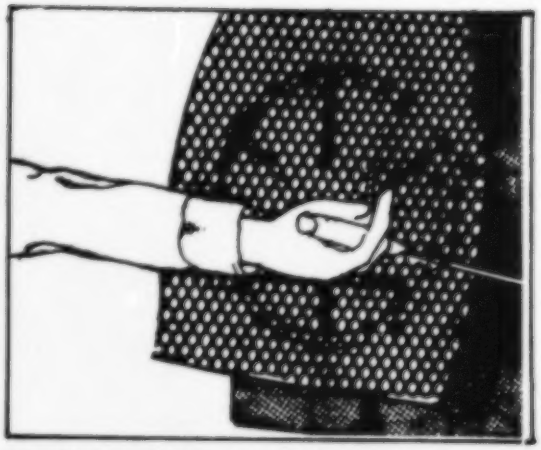
STEP 3 – The motor pulley has two sides that can be moved closer together or farther apart. When the two sides are close together the V-belt rides high on the pulley and increases the speed of the blower.



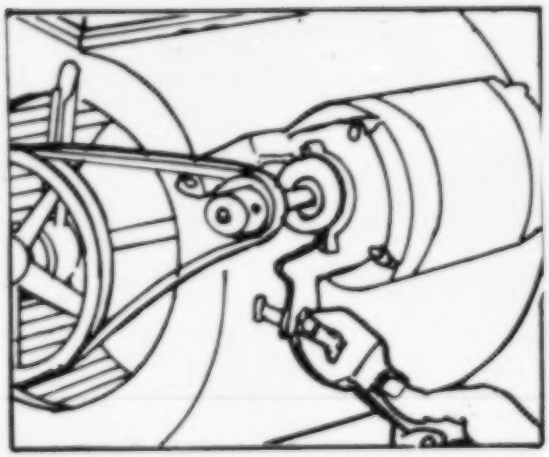
STEP 4 – Widening the space between the sides lowers the V-Belt's position – decreasing the effective diameter of the pulley and decreasing the speed of the blower.



STEP 5 – To adjust the blower speed, loosen the set screw on the outer side and turn the pulley side counterclockwise to increase the width of the pulley (decreases blower speed) or clockwise to decrease the width of the pulley (increases blower speed).



STEP 7 – Replace the safety guard.



STEP 6 – Tighten the set screw, readjust pulley alignment and V-Belt tension.

Check Point

Go to your instructor and get the handout for Warm Air Blower, Instructional Objective IV.

Read the statements and circle the letter next to the correct response.

Go back to your instructor and ask to see the correct answers.

WALL HEATERS

INTRODUCTION

In this type of heating system,each room has its own heating unit. This type of system is easy to install because it has no ductwork or plumbing but it is expensive to operate and slow to heat the room.

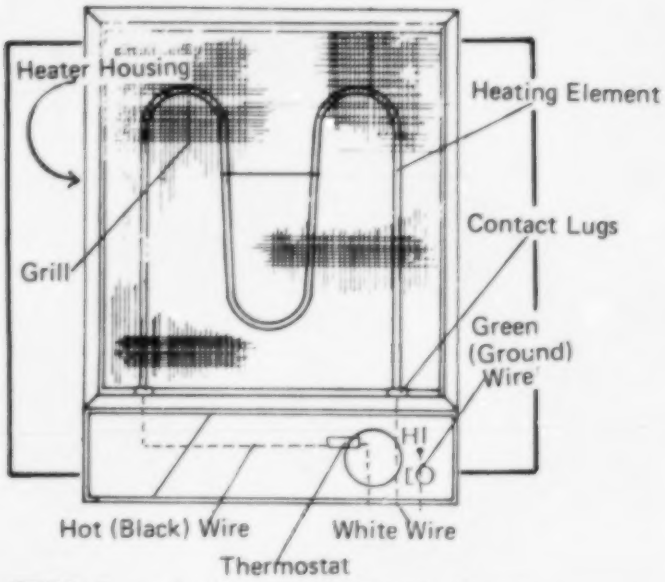
In this activity you will learn how a Baseboard or Wall heating unit works and how to check to see if it is operating properly.

GOALS

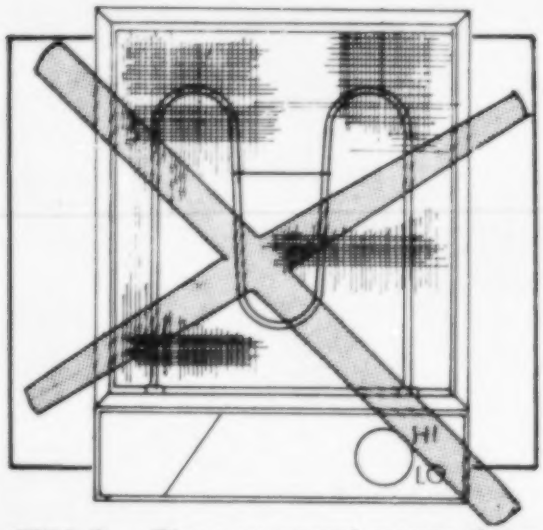
1. The student will understand the operation of a Baseboard heating system.
2. The student will learn how to maintain a Baseboard heating system.
3. The student will learn the terminology related to Baseboard heating units.

Instructional Objective 1

The student will indicate the reasons why a wall heater might not work.

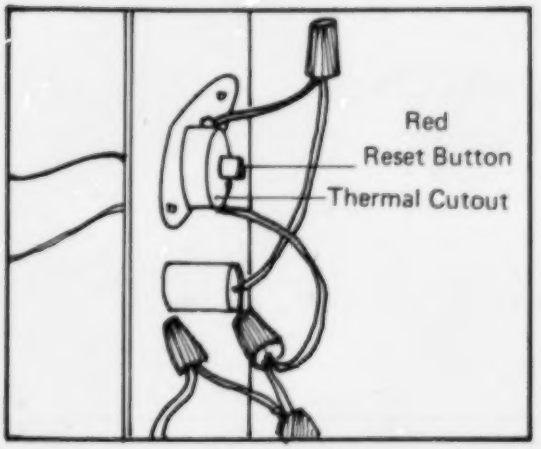


STEP 1 – A Wall or Baseboard Electric Heater heats the surrounding air when power flows from the hot (black) wire in a power cable through a resistance wire or heating element. See Diagram.



STEP 2 – There are several reasons that a Wall or Baseboard Heater may not operate properly. In the following steps we will discuss these and how to fix them.

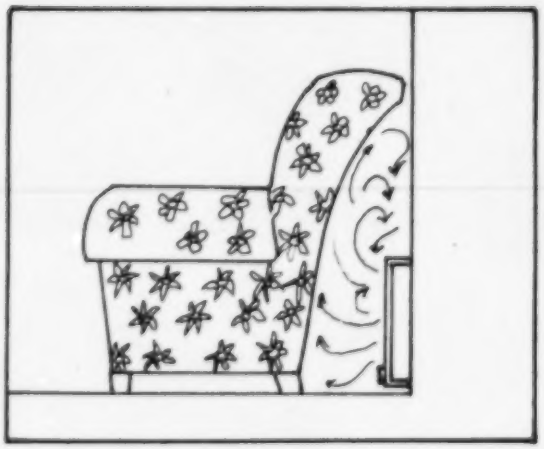
STEP 3 – If the Wall or Baseboard Unit does not heat, you may have a blown fuse or a tripped circuit breaker. To remedy this situation – replace the fuse or reset the circuit breaker.



STEP 5 – Your Wall or Baseboard Heater may have a Thermal Cutout. This Thermal Cutout works the same way as a circuit breaker. Most thermal cutouts have a red reset button – push this button to make sure the thermal cutout is reset.

Check Point

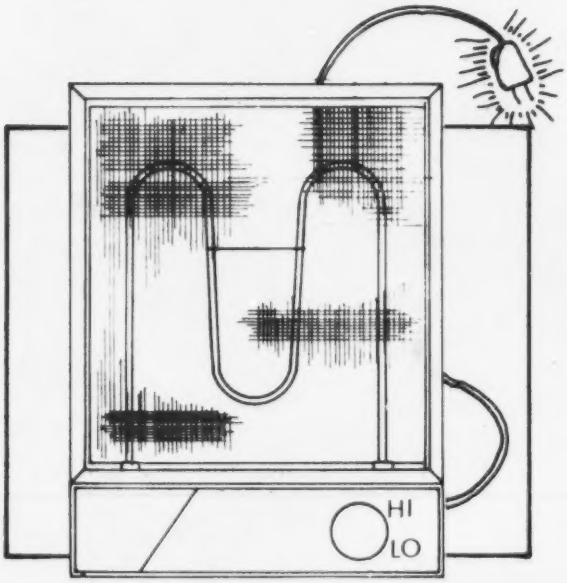
Are you able to indicate the reasons why a wall heater might not work?



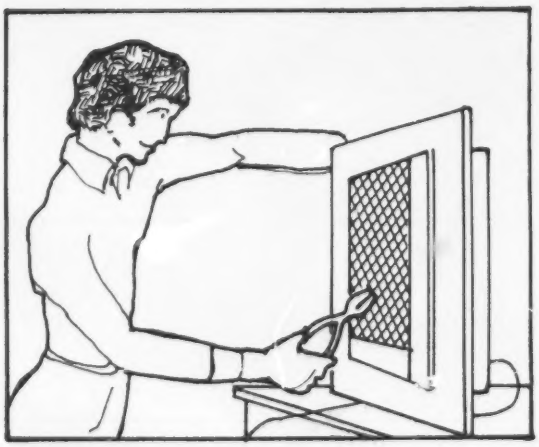
STEP 4 – One cause of the fuse blowing or the circuit breaker tripping is that the air flow around the heater has been blocked. Do not arrange furniture or curtains so that they block the flow of air around the heater.

Instructional Objective II

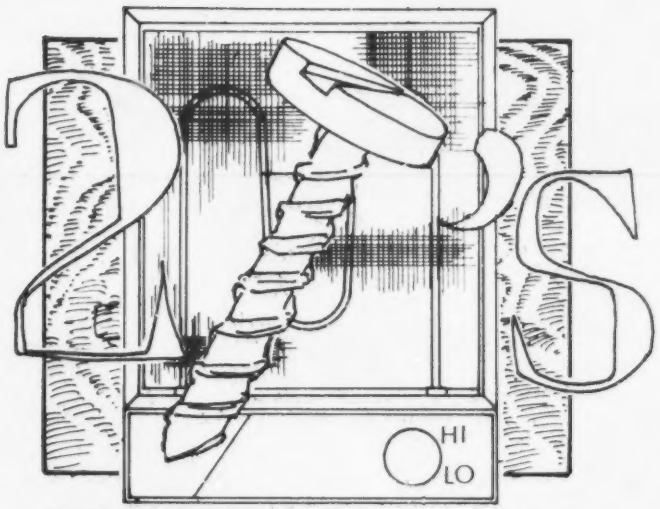
The student will change the heating element in a wall heater.



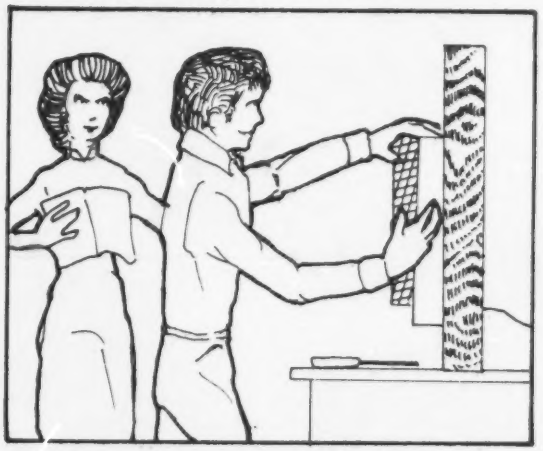
STEP 1 – Make sure the display model Wall Heating Unit is unplugged.



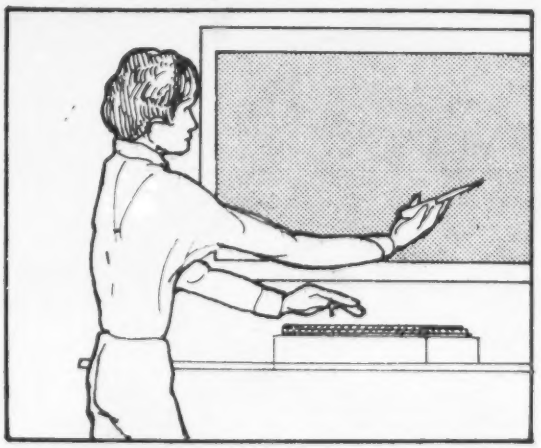
STEP 2 – In the following steps we are going to take the display model Wall Heating Unit apart (make sure the unit is unplugged).



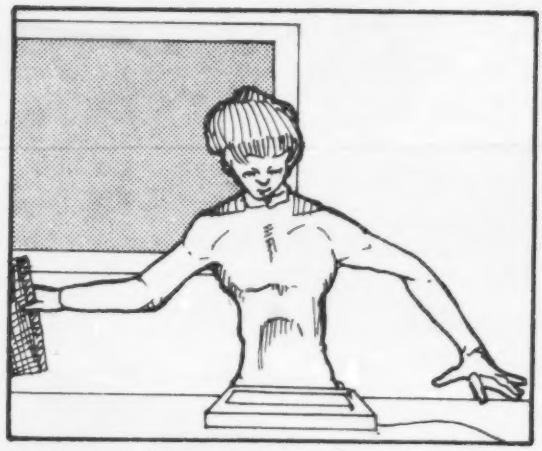
STEP 3 – Loosen (Do Not Remove) the two screws that hold the unit in place.



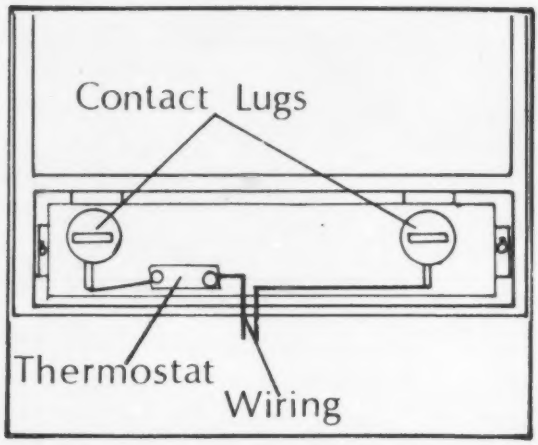
STEP 4 – Pull up on the grille and pull out (make sure power cord is feeding through the back of the display model cabinet).



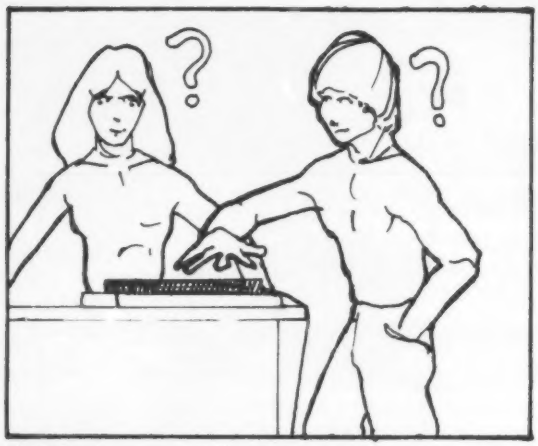
STEP 5 – Remove grille by removing the screws from the top and bottom of the grille.



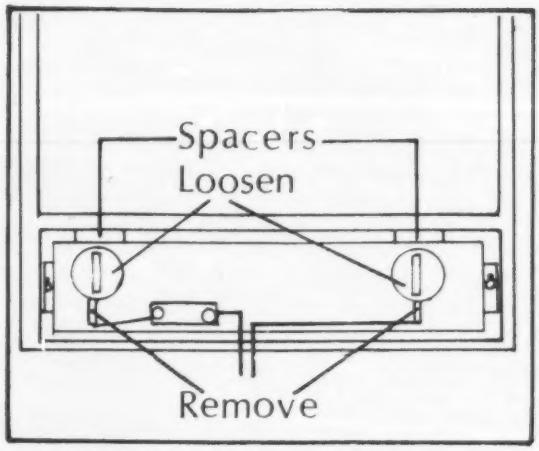
STEP 6 – Look at the back of the Heating Unit.



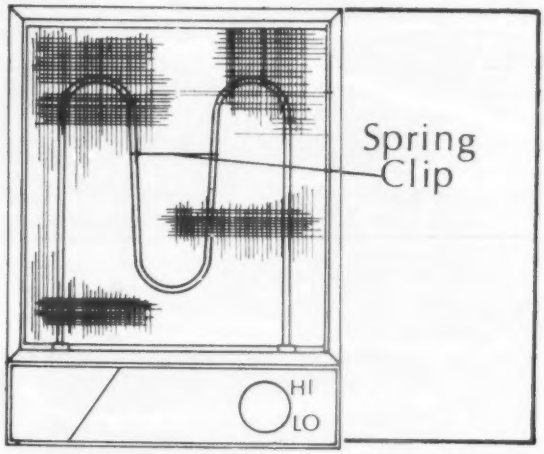
STEP 7 – At the bottom of the unit you will notice the contact lugs, the back of the thermostat, and the wiring.



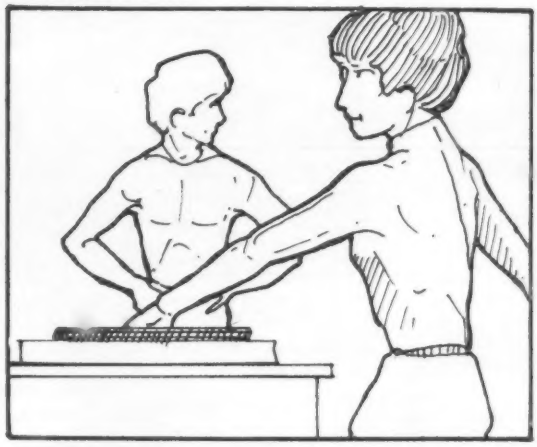
STEP 8 – A defective heating element is another cause of lack of heat – in the following steps we will describe how to replace the heating element.



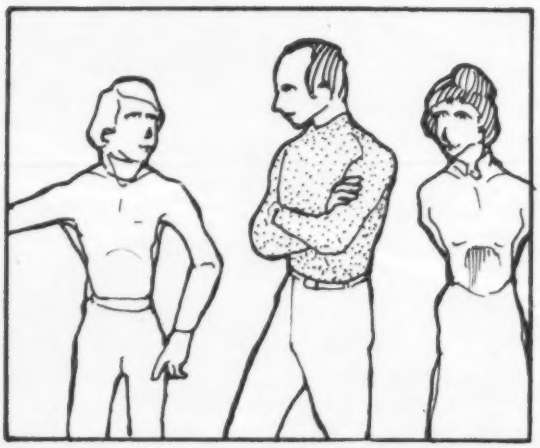
STEP 9 – Loosen the contact lugs and remove the wires from them by gently pulling the wires away from the lugs.



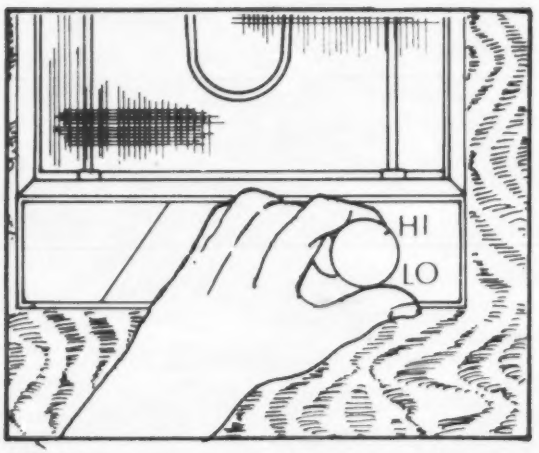
STEP 10 – Remove the spring clip that supports the heating element and remove the heating element.



STEP 11 – Reassemble the Wall Heating Unit Display Model with a new heating element. Simply reverse the steps for taking it apart.



STEP 12 – Have your instructor check to make sure you have reassembled the unit correctly.



STEP 13 – Plug in the Wall Heating Unit and turn the thermostat to "high" – turn the thermostat to "low". Notice the operation of the unit.

Check Point

Go to your instructor and get the handout for Wall Heaters, Instructional Objective II.

On the lines next to the names of the parts, write the letter that you think indicates the part on the illustration.

Go back to your instructor and ask to see the correct answers.

869.281-010 FURNACE INSTALLER–AND REPAIRER, HOT AIR (any ind.) furnace worker; heating worker.

Installs and repairs hot-air furnaces, stoves, and similar equipment in accordance with diagrams and other specifications, using handtools and pipe-threading tools: Constructs foundation of concrete or other non-combustible materials. Assembles and positions heating units in accordance with diagrams, using handtools. Cuts holes in floors and walls to form air-duct outlets. Installs air ducts, smoke pipes, blowers, and stokers, following blueprints of building, and using handtools. Installs fuel pipes, using dies, pipe cutters, and pipe wrenches. Wraps insulating asbestos around air ducts. Connects and adjusts timers and thermostats. Inspects inoperative heating units to locate causes of trouble. Disassembles heating unit and replaces or repairs defective parts, using handtools. Cuts, bends, and crimps sheet metal to repair furnace and stove casing and pipes, using crimpers, files, snips, handbrakes, and sheet metal hammers. Reassembles and starts heating unit to test operation.

007.181-010 HEAT–TRANSFER TECHNICIAN (profess. & kin.)

Plans requirements for fabricating, installing, testing, and servicing climate control and heat transfer assemblies and systems to assist engineering personnel, utilizing knowledge of heat transfer technology and engineering methods: Calculates required capacities for equipment units of proposed system to obtain specified performance and submits data to engineering personnel for approval. Studies supplier catalogs and technical data to recommend equipment unit selections for system. Prepares unit design layouts and detail drawings for fabricating parts and assembling system. Estimates cost factors, such as labor and material for purchased and fabricated parts, and costs for assembling, testing and installing in customer's premises. Fabricates non-standard parts for system, using metalworking machinery and assembles system, using handtools and power tools. Installs test fixtures, apparatus, and controls and conducts operational tests under specified conditions. Analyzes test data and prepares report for evaluation by engineering personnel. Installs system in customer premises and tests operational performance for compliance with contract specifications and applicable codes. Diagnoses special service problems of systems under service contract and writes instructions for service or repair personnel. May be designated according to specialty as AIR–CONDITIONING TECHNICIAN (profess & kin.); HEATING TECHNICIAN (profess. & kin.); REFRIGERATING TECHNICIAN (profess. & kin.).

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